NomaticBubbles: Visualizing Communal Whereabouts

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CHI 2008, April 5–10, 2008, Florence, Italy.
ACM 978-1-60558-012-8/08/04.

Abstract
This paper describes the design of the NomaticBubbles, a visualization that provides cues of communal whereabouts. Unlike most location displays showing whereabouts on a geographical map, the NomaticBubbles depicts historical and aggregate traces of participants' whereabouts in an abstract and ambiguous manner. We describe the design of the NomaticBubbles, and discuss some early experiences and feedback we got, as well as future work.

Keywords
Location, awareness, social visualization, social computing, design

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
With the arrival of ubiquitous computing, location based systems have been a core topic. One research direction is to explore whether and how location might be disclosed and shared to one another to increase awareness, inform coordination, support collaborations or enhance connections. We call these systems location awareness displays. Example explorations include WebWho [4] which enables locating people in a large university computer lab, ActiveMap showing where people are in a workplace environment [5], and

Whereabouts Clock displaying family members' current location in one of the four coarse-grained categories [1]. Studies of these systems have uncovered a range of design tradeoffs such as accuracy and performance, location awareness and privacy needs, etc.

Despite the large body of work on location awareness displays, their design is either limited to a certain geographical place such as a building or a campus, or limited to close-knit social relationships such as among family members. One reason is the cost and coverage issues. Especially, early work of locating systems such as ActiveBadge [7] relies on expensive infrastructures embedded in a building environment, which limits the scope and the kinds of location information available. Recent locating technologies such as Placelab [3] leverage the already widespread WiFi infrastructure thus greatly overcome cost issues and coverage problems. However, moving outside of a well-controlled environment poses great challenges of how to represent the location meaningfully (e.g. instead of showing longitude and latitude, how to translate position into semantically meaningful place names that can be recognizable by people). Another reason is privacy concern. For the potentially sinister connotation of "tracking" or "monitoring", location awareness is usually constrained to limited social configurations such as family [1], and close-knit social networks [2].

To expand the design space of location awareness displays, we aspire to employ several strategies to address these issues. First, our approach to location inference is based on WiFi infrastructures, which ensures cheap and wide coverage of possible locations (as wide as how WiFi infrastructure can reach) [6]. Second, we use abstract depiction instead of geographic map to portray location information, thus locations of various kinds can be represented in a compact yet meaningful way. Furthermore, the visualization is deliberately designed to be ambiguous, as a way to leverage social mechanisms to engage with it fully and meaningfully (only people who know the community well can interpret easily with the visualization). Finally, the location information is not based on passive tracking, but on active reports, which allows participants to manage the line between privacy and self-presentations.

Thus, by designing systems that incorporate these strategies, we want to explore whether and how these strategies might overcome difficulties of deploying location awareness systems, expand the design space of location awareness displays beyond previous examined presence, settings and social configurations (e.g. formal organization, family, etc), and deepen our understanding of what and how location based social visualization mean and do for community of practices.

NomaticBubbles

The NomaticBubbles is our first prototype designed to investigate location awareness issues in a community. Based on Nomatic*IM (described in more details below) for its input, the NomaticBubbles visualization uses graphic representations to depict historical and aggregate location traces of a community. As of this writing, the NomaticBubbles has been made available both on an online webpage and a public display in the community's space.

*Nomatic*IM*

Nomatic*IM was originally designed to provide more specific status information through Instant Messaging

(IM) to inform online communications. It is a software component installed on the user's computer. It collects sensor data (e.g. WiFi, IP address, power sources, etc.) as well as users' descriptions of their context, and associates the sensor data with users' descriptions. Figure 1 is a user interface of Nomatic*IM. It allows users to specify current location, activity and other information. Nomatic*IM manages and processes the user's input as well as corresponding sensor data. Based on machine learning technologies and after enough training, Nomatic*IM is capable of automatically suggesting relevant contextual information with minimal user effort.

For the discussion here, Nomatic*IM was mainly employed to provide data source for location awareness display investigations. Users' contextual descriptions and sensor data are collected and stored in a central database, and the visualization component will fetch the data and visualize it.

The Visualization

Figure 2 shows the first implementation of what we call NomaticBubbles.

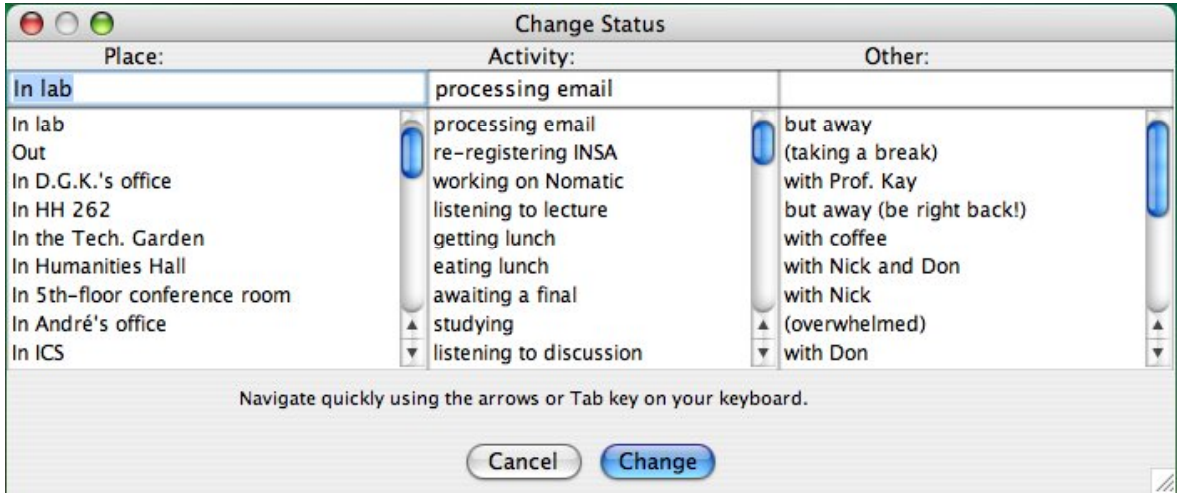

figure 1. The interface of Nomatic*IM for disclosing user's contextual status.

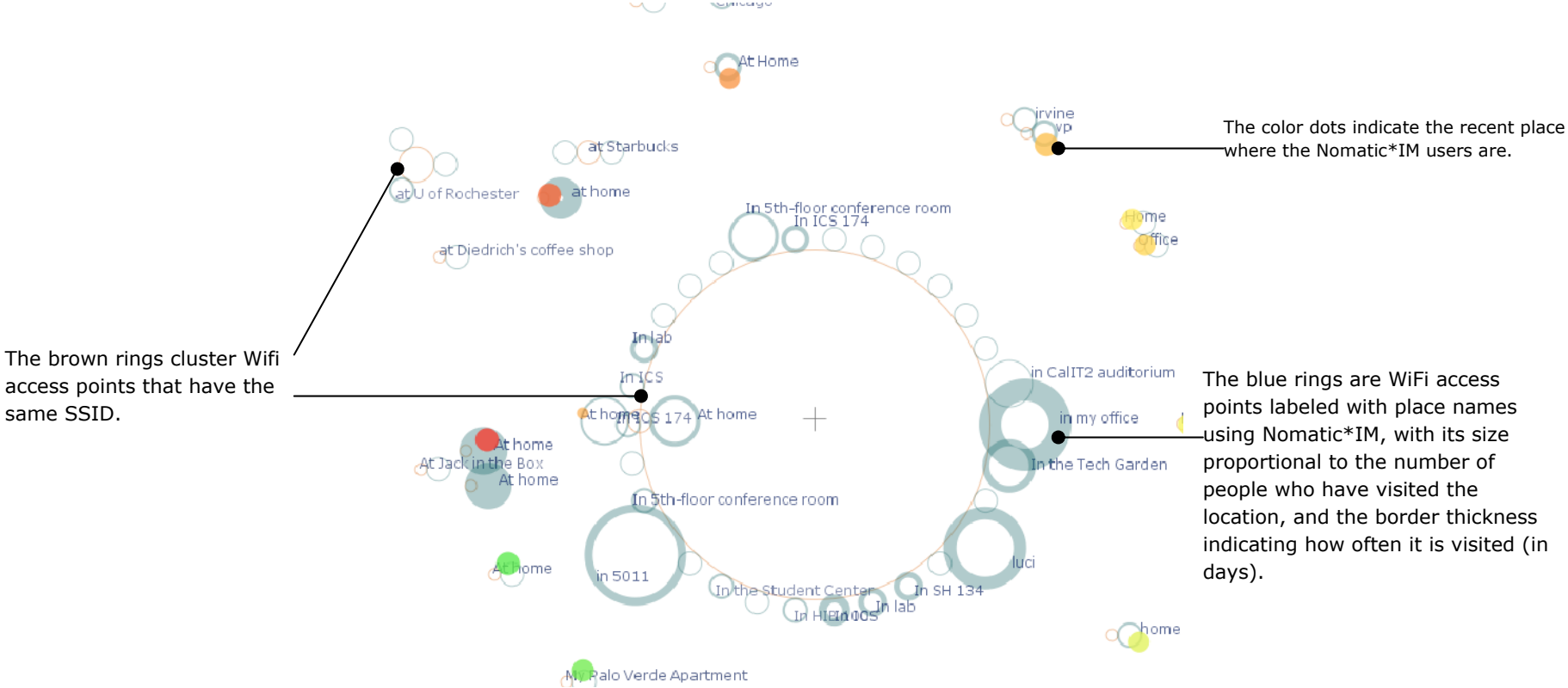

Figure 2. A snapshot of the NomaticBubbles with thirty days' worth of data. The largest brown ring at the center is the school campus.

The blue rings are WiFi access points labeled with place names using Nomatic*IM. The size of the blue ring indicates the number of people who have visited the location, while the border thickness indicates how often it is visited (in days). The brown ring clusters Wifi access points that have the same SSID. Its position is determined by its size (the number of WiFi hotspots associated) and the recency of the last visit – the more WiFi hotspots and the more recently visited, the closer to the visualization center (marked by a cross mark), and vice versa. The color dots represent different Nomatic*IM users and each is placed at the hotspot ring s/he last visited.

Thus, in the NomaticBubbles visualization, instead of using literal geographical map as its layout, its layout is dynamically determined by users' collective interactions with the WiFi infrastructure; instead of showing current locations, it depicts historical traces of people's whereabouts (e.g. in last thirty days); instead of using people icons, it uses different colors to distinguish individuals (therefore, while it is clear to insiders which color represents whom, it is unclear and ambiguous to others).

Installation

To make it more accessible, the NomaticBubbles visualization has been made available on a big screen on the wall at the elevator (also as the entrance) to our department (Figure 3). At the same time, it is also accessible through a password protected website. The information on both visualizations is updated on real time (every minute). At this initial stage, the location data is mainly based on the input from our Nomatic*IM research team, with few from those who expressed interests in trying the system.

Preliminary Feedback

As of this writing, the NomaticBubbles has been deployed on the big screen and the web site for more than a month. They showed location information of our Nomatic*IM research team, and worked mainly as a demo to recruit more users for more formal investigations. While we have not yet done a formal study to collect and analyze the usage data, we have a number of results based on our own experiences, on informal observations, on web access logging, on demos to external organizations, and on a short survey of people's initial experiences with the NomaticBubbles.

figure 3. NomaticBubbles on a big screen on the wall at the elevator to the community space.

The reception of an abstract and ambiguous representation of locations on the visualization is quite mixed. The first problem encountered is accessibility. While we have made specific effort to make visualization more accessible (e.g. through the web thus users do not need to install a new client component, and through a public display in a shared space), it is still not accessible enough. From the feedback, two factors appear important: First, the design is abstract and untraditional, so it is not as intuitive as a map to tell immediately that it is about location information and usually explanations are needed to really understand it; Second, the physical condition of the deployment setting restricts its accessibility - the elevator is too transitional a space for them to spend time learning what is going on in the visualization, and there is still too much overhead to access the visualization on the web (people usually forget to check the web page).

On the other hand, despite some accessibility problems, users' reactions do verify some of the design concepts. Users' ability to interpret the visualization is based on their engagement with this group. While users can not interpret all traces, they can gain general impressions of the overall activities of the community, can easily recognize and interpret some of them, e.g. which ring or dot is from whom either because they are on each other's IM buddy list (the same contextual information is also shown on their IM's status bar), or because they are familiar with each other already, or because they spend enough time in the shared office space. Furthermore, it also seems effective to address some privacy issues for it appears anonymous to most people. For example, while asked some students whether they felt comfortable to share their locations, they answered, "*as long as other don't know that it's me. It's fine with me… Or as long as [my advisor] doesn't know where I am…"* Finally, although many can't interpret the visualization fully, some were excited with the visualization, and felt good to learn that many people worked here with them too.

Ongoing and Future Work

We are currently engaged in building a next generation of context aware visualizations. First, we want to greatly simplify the design so users can quickly notice the most prominent information such as the most recent activities at a glance, as a way to fit into the transitional space such as the elevator. Second, we will highlight the rhythm of activities since many expressed interests in seeing historical changes. Finally, we will incorporate other contextual information such as activities besides locations because many see location as indicators of activities.

We are also in the process of recruiting users beyond the Nomatic*IM research team, and plan a more formal study of the interplay between the context aware visualizations and everyday practices in the community.

Acknowledgements

We are grateful to the Nomatic*IM team for their support and early feedback.

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